

NEW SPECIES OF AFRICAN SIMULIIDAE AND FURTHER STUDIES
OF THE EARLY STAGES.

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(Plates XIII & XIV.)

It has been stated by Malloch and other authors that the superficial differences between the various species of *Simulium* in the adult stage are often so minute as to be discernible only after a very careful study of the genus. Previous studies had led the writer to believe that the characters of the pupal respiratory filaments would prove to be of constant specific value, but further investigation has caused this view to be modified with regard to the actual branching, though the structure of the chitinous wall and the general appearance still seem to be constant specific characters.

In the case of one species described in this paper, *S. hirsutum*, and the varieties *S. hirsutum* var. *dubium* and *S. hirsutum* var. *adersi*, though the branching of the filaments varies very considerably, even in the same pair of filaments from the same individual pupa, yet the chitinous structure of the filament wall appears to be the same in all specimens.

The difference in the position and actual number of the branches seems quite understandable from a morphological point of view and may be explained on the supposition that the filaments primarily arise from three main stems, which form into a single stem at the base. The pupa of the var. *dubium*, though bearing the same number of branches as the type that has been selected as the true *hirsutum*, namely eight, differs in that the branching takes place, in the case of the second and third main stems, at a very considerable distance from the base.

These two forms were taken from the same locality and were in the greatest number amongst the specimens obtained, though individuals were taken at the time showing considerable variation in the distance of the branching point from the base. With regard to the form *adersi*, this was obtained from a very different locality and altitude, but it will be seen from the figure given (Pl. xiv, fig. 6) that the first main stem has developed a further branch, the second main stem divides again into two more branches and in the case of the third main stem the branching appears to have retracted until the three branches arise from nearly the same point. The position of the branching of this form appears to vary very considerably in a series of specimens, but no difference can be observed in the chitinous structure of the outer wall. The male genitalia, wing venation, hind claws of the female, and the general appearance and colour of the adults of all these three forms appear to be the same.

A similar case of variation in the pupal branching occurs in the species *S. alcocki*, *S. alcocki* var. *violaceum* and *S. alcocki* var. *coalitum*, described in this paper. The adults of these varieties appear to differ slightly in colour, but in no definite structural character.

The actual position of the branching of the filaments may depend a great deal on the growth of the larva. Taylor* states that the rudimentary pupal filaments are developed in the very young larvae at the same time as the imaginal rudiments; on this point the writer is fully agreed.

* Taylor, T. H., Trans. Ent. Soc., London, 1902, pp. 701-716.

Two pupae of entirely different species have been obtained by the writer in which the pupal filaments coalesce for a very considerable distance before branching, forming a peculiar long main stem. In the case of one of these pupae, described in this paper as *S. alcocki* var. *coalitum*, the imago was well developed within, and the male genitalia were dissected out, proving identical with those of the true *S. alcocki*.

As regards the other aborted form, the imago was not sufficiently developed to allow of a positive determination, but from the number of the branches and the chitinous structure of the outer wall, it seems to be a form of *S. hirsutum*. It is rather remarkable that only single specimens of such aborted pupae were found among some hundreds of pupae collected and examined, and that the same type of malformation occurred in two very different species. It is suggested that this may be due to some adverse condition during the growth of the larval stage.

The writer is now engaged on a monograph of the genus, and from present knowledge it would seem that the inter-relation of the species may be best determined from the combined characters of the wing venation, the male genitalia, the hind claws of the females and the chitinous structure and general appearance of the pupal filaments.

Simulium hirsutum, sp. nov.

♂. *Length*, 1.4 mm. *Antennae* black, covered with short grey pubescence. *Thorax* velvet-black, covered with deep golden pubescence. *Pleurae* brown, lacking patch of soft hairs on membranous area. *Wings* hyaline, radius unforked. *Abdomen* velvet-black, with iridescent patches on the 2nd, 5th and 6th segments, abdominal scale bearing a fringe of long yellow and brown hairs, the first three segments covered with golden pubescence dorsally. *Legs*: front legs rich brown, the femora covered with dull golden hair; hind legs, coxae brown, with a few pale yellow hairs, remainder of leg rich purple-brown, covered with brown hairs and a few scattered golden hairs, second tarsal joint with deep excision near base. *Genitalia* (Pl. xiii, fig. 1): basal pieces large; claspers about half the length of the basal pieces, very peculiarly constructed, the interior margin being extended and folded over into a rectangular flap, the apex of the clasper pointed and bearing a "bill-shaped" finger-like process; anal plates not very well defined and bearing a fringe of stout bristles on the outer margin; adminiculum very broad, bearing a well defined pouch covered with short curved hairs arising from well defined pits; arms ending mesally in a single rather short and very stout spine turned outwardly.

Habitat.—Described from six specimens reared from pupae found attached to grass blades in a swift-flowing mountain stream.

TANGANYIKA TERRITORY: Morogoro, 21.xi.1917.

Type in the British Museum.

♀. *Length*, 1.5 mm. *Head*: frons and face dark purple-grey, covered with golden pubescence; *antennae* dark purple-brown, covered with dark grey pubescence. *Thorax* and *scutellum* very dark purple-brown, almost black, covered with golden pubescence. *Pleurae* brown, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* deep brown, thickly covered with light golden hairs. *Legs*: front legs deep purple-brown, femora and tibiae covered with coppery pubescence; hind legs purple-brown, the pubescence darker at joints and interspersed with a few light yellow hairs, especially on the tibiae and metatarsi; tarsi dark brown, second tarsal joint with excision near base, claws with a prominent tooth at base.

Habitat.—Bred from pupae from same locality and on same date as male type. Not found biting.

Pupa, type form (Pl. xiv, fig. 4).—The respiratory filaments are eight-branched, arising from three main stems: the first dividing dichotomously; the second dividing

dichotomously and then dividing once again, forming three in all; and the third dividing dichotomously and once again in the same way but nearer the base. This is a very common type.

Pupa var. **dubium**, nov. (Pl. xiv, fig. 3).—The filaments are eight in number, but the second stem divides again very much more distally from the base, and the third main stem divides again at about two-thirds the entire length from the base.

The typical pupa and this variety were taken from the same locality and on the same date as the male type.

Pupa var. **adersi** nov. (Pl. xiv, fig. 6).—The respiratory filaments are 11 in number, arising from three main stems at base: the first divides into three branches: the second divides into three, the first two again dividing dichotomously, making five in all; and the third divides into three very near the base. The position of the branching of the third main stem varies greatly, even in the filaments on either side of the same individual. The same number and general arrangement seems very constant in this form, no really intermediate forms having been obtained as yet.

EAST AFRICA: Zanzibar, 22.vii.1917, from grass blades in small stream.

The genitalia of the males, the female structure and the general coloration of the adults appears to be the same in all specimens bred from or dissected from the three types of pupae.

Simulium alcocki, sp. nov.

♂. *Length*, 1.5 mm. *Antennae* dark brown, covered with grey pubescence, the first two segments naked and distinctly reddish-brown. *Thorax* and *scutellum*, very dark velvet-brown, covered with light golden pubescence. *Pleurae* fuscous, lacking patch of soft hair. *Wings* hyaline, radius unforked. *Abdomen* velvet-black, basal scale bearing a long fringe of pale yellow hairs, a diagonal lustrous blue stripe on either side of the 2nd, 5th and 6th segments. *Legs*: front legs, coxae and femora straw-coloured, dark brown at apex, tibiae straw-coloured, dark brown just at basal joint, more so at apex, tarsi dark brown; hind legs, coxae yellow, femora yellow, brown at apex, tibiae yellow, dark brown at base and apex and along outer margin, metatarsi pale yellow, dark brown at apex and along inner margin, remainder of tarsi brown, second tarsal joint with slight excision near base. *Genitalia* (Pl. xiii, fig. 4): basal pieces large; claspers about two-thirds the length of the basal pieces, rather thick, tapering at apex, which bears a short finger-like process; anal plates long, rather cup-shaped at apex and bearing numerous hairs and bristles; adminiculum broad, apical margin forming a lip covered with a fringe of short curved hairs; arms ending mesally in a single long strong spine, turned back outwardly.

Habitat.—Bred from pupae attached to grass blades in slow-moving stream.

NIGERIA: Ibadan, 500 ft., 6.xii.20.

Type in the British Museum.

♀. *Length*, 1.6 mm. *Head*: frons and face grey, covered with silver pubescence; *antennae* fuscous, covered with short grey pubescence, the first two and part of the third segments deep orange. *Thorax* dark lustrous grey, completely covered with dense brassy pubescence in the case of freshly emerged specimens, silvery towards outer margin. *Pleurae* brown, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* dark brown, the first six segments covered with golden hair, the 7th and 8th tergites rather bare, shining, with a few sparse black bristles. *Legs*: front legs, coxae yellow, femora and tibiae yellow, dark brown at joints, tarsi brown; hind legs, coxae yellow, femora yellow, black at apical joint, tibiae brown, yellow at base and banded yellow across middle, metatarsi pale yellow, dark brown at apex, remainder of tarsi black, second tarsal joint with excision near base; claws with prominent tooth at base.

Habitat.—Bred from pupae found at same locality and date as male type. Not found biting.

Paratype in the British Museum.

Pupa, type form (Pl. xiv, fig. 7).—Respiratory filaments seven-branched, arising from three main stems. The first main branch divides dichotomously at some distance from base; the second divides dichotomously and once again, making three branches in all; the third divides dichotomously at some distance from the base, but arises in conjunction with the second rather than from the main base.

Pupa var. violaceum, nov. (Pl. xiv, fig. 8).—The respiratory filaments differ from those of true *S. alcocki* in being ten-branched, and arise from the main base at a wider angle. The third main stem subdivides into five branches in all.

The adults appear to differ slightly in coloration, the males having a more pronounced violet area on the sides and on the dorsal portion of the first segment of the abdomen. There appears to be no difference in the characters of the male genitalia.

Habitat.—Pupae obtained and adults reared from same locality and on same date as the type of *S. alcocki*, also on subsequent dates.

Types in the British Museum.

Pupa var. coalitum, nov. (Pl. xiv, fig. 1).—The respiratory filaments of this form show a very peculiar development. The branching takes place at a very considerable distance from the main base, there being 10 branches in all. The general arrangement is similar to that in *S. alcocki* var. *violaceum*, but the branches seem to have been welded together as the result of malformation. The genitalia of the male imago, which was well developed within the specimen obtained, showed no difference in character from those of the true *S. alcocki*. More material may show that this form is a reversion or modification of some earlier type from which both the forms *S. alcocki* and *S. violaceum* have evolved, especially as a similar case occurs with *S. hirsutum*.

Simulium divergens, sp. nov.

♂. *Length*, 1.7 mm. *Antennae* light brown, covered with fine light pubescence. *Thorax* deep velvet-brown, covered with light golden pubescence. *Pleurae* light brown, lacking patch of soft hair. *Wings* hyaline, radius unforked. *Abdomen* deep velvet-brown, almost black, covered with light golden hairs dorsally, lower surface of abdomen light brown. *Legs*: front legs with coxae and femora honey-yellow, tibiae light brown at base and apex, tarsi very dark brown, almost black; hind legs with coxae yellow, femora yellow, with very dark brown area at apex, tibiae dark brown, pale at basal joint and across middle, tarsi almost black, second tarsal joint with excision near base. *Genitalia* (Pl. xiii, fig. 3): basal pieces broad; claspers about two-thirds the length of basal pieces, the distal portion turned almost at right angles, the apex of the outer margin pointed and bearing a very short single finger-like process; anal plates broad, inner margin with a fringe of short spines; adminiculum very broad, bearing a narrow pouch in centre covered with short hairs arising from distinct pits; arms very strong and ending mesally in a single very strong blunt spine, turned outwardly, behind which lies a thin membranous area more strongly defined along the dorsal margin.

Habitat.—Bred from pupae attached to grass blades in slow-moving stream.

NIGERIA: Ibadan, 4.xii.1920, 500 ft.

Type in the British Museum.

Described from a single specimen bred from pupa and from a specimen dissected from pupa.

♀. *Length*, 1.7 mm. *Head* with frons and face dark brown, pollinose, covered with pale yellow pubescence; antennae dark brown, covered with minute pubescence, 1st, 2nd, and part of 3rd segments honey-yellow. *Thorax* black, with dull greenish tints, covered with light brassy pubescence, silvery towards sides, the usual lyre-shaped vittae prominent; scutellum covered with very long pale brassy hairs. *Pleurae* dark brown, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* dull brown, first three segments covered with dull golden hairs dorsally, last three segments shining dorsally and covered with sparse yellowish hairs. *Legs*: front legs with coxae yellow, femora and tibiae yellow, dark brown at apical joints, tarsi brown, almost black; hind legs with coxae yellow, femora yellow, but dark brown at apex; tibiae dark brown, pale yellow at apical joint and diagonally across middle; basal two-thirds of metatarsi yellow, remainder of tarsi brown, almost black, second tarsal joint with excision near base, claws with prominent tooth at base.

Habitat and locality the same as for male type. Not found biting. Described from a single specimen bred from an isolated pupa.

This species is closely allied to *S. aureosimile*, Pomeroy, but differs in some of the characters of the male genitalia, the coloration of the female, and in the structure of the pupal filaments.

Pupa.—Cocoon strong, but somewhat loosely woven, of the wall-pocket type, but without "side openings." Respiratory filaments four-branched (Pl. xiv, fig. 2). The first two arise from a main stem, which is narrowed at base. The remaining pair branch from a stem at a short distance from the main base. The angle between the filaments is very wide. The ends of the branches are rounded and the chitinous wall is rather weak. The surface of the chitin, which is covered with minute nodules, is very different in appearance from that of *S. aureosimile*. Pupa described from the specimen from which the male type emerged.

***Simulium vorax*, sp. nov.**

♀. *Length*, 2.5 mm. *Head* with frons and face grey, covered with shining yellow-grey pubescence; antennae dark brown, covered with very short fine grey pubescence, the 1st, 2nd and part of 3rd segments clear brown-orange. *Thorax* dark lustrous grey, brown-grey at sides, the lyre-shaped vittae very dark, prominent and curved; the entire surface in fresh specimens covered with thick light greenish-golden pubescence; scutellum covered with long greenish-golden hairs. *Pleurae* brown-grey, pollinose in some lights, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* dull velvet-black, thickly covered with shining yellow-grey pubescence arranged in whorls, the last three segments less dull, and the 8th and 9th segments with long pale yellow-grey hairs interspersed among the pubescence. *Legs*: front legs, dark brown, the coxae and basal half of the femora and basal two-thirds of tibiae covered with shining yellow-grey hair, tarsi dark brown, almost black; hind legs dark brown, basal half of femora and basal two-thirds of tibiae covered with shining yellow-grey hair, tarsi rich dark brown, almost black, basal half of metatarsus, with exception of inner margin, covered with shining yellow-grey hair, second tarsal joint with excision near base, claws simple, with no tooth.

Habitat.—Taken biting voraciously and engorging on donkey near stream. Described from 35 specimens taken at same time and place; ♂ unknown.

TANGANYIKA TERRITORY: Amani, 14.xii.1917.

Type in the British Museum.

This species is very near to *S. neavei*, Roub., but differs especially in size, and in the shape and colour of the thorax, which is uniformly dull black in the latter species.

Simulium unicornutum, Pomeroy.*

♂. *Length*, 1.5 mm. *Antennae* fuscous, heavily covered with silver-grey pubescence. *Thorax* velvet-black, covered with thick golden pubescence; metathorax slate-blue and scutellum black, both covered with thick golden pubescence and long golden hairs. *Pleurae* fuscous, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* velvet-black, with iridescent violet-blue patches on 2nd, 5th and 6th segments. *Legs*: front legs with coxae, femora and tibiae honey-yellow, dark brown at the apex of the tibiae and a dark brown spot at the apex and near the base of the femora, tarsi black; hind legs with coxae fuscous, femora honey-yellow, dark brown at apex; tibiae dark brown, banded yellow at apex and across middle; basal two-thirds of metatarsi pale, remainder of tarsus black, second tarsal joint with excision near base. *Genitalia* (Pl. xiii, fig. 2): basal pieces rather broad; claspers a little longer than the basal pieces and rather tapered towards the apex, which bears a single finger-like process; anal plates rather short, bearing a clump of bristles at apex and a few stout hairs at base; adminiculum very broad, concave at the centre, which bears a patch of numerous small curved hairs; arms very strong, ending mesally in a single long spine turned outwardly.

Habitat.—Bred from pupae attached to grass blades in small stream.

NIGERIA: Ibadan, 500 ft., 6.viii.1920, 9.xii.1920, 11.xii.1920.

Described from specimens bred from isolated pupae corresponding in all details to the type. Material placed in the British Museum.

♀. *Length*, 2.6 mm. *Head* with frons and face silver-grey, with light golden pubescence; antennae fuscous, covered with fine grey pubescence, 1st, 2nd and part of 3rd segments dull orange. *Thorax* and *scutellum* very dark grey, covered with light greenish-golden pubescence. *Pleurae* dark brown, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* dark brown, basal scale with fringe of long golden hairs, the three basal segments covered with golden pubescence, the last three segments shining dorsally. *Legs*: front legs with coxae and femora honey-yellow, tibiae yellow, banded dark brown just above base and at apex, tarsi dark brown; hind legs with coxae and femora honey-yellow, latter dark brown at apex, tibiae dark brown, banded yellow at base and across middle; basal two-thirds of metatarsus yellow, remainder of tarsus dark brown, second tarsal joint with excision near base, claws with prominent thick tooth at base.

Described from many specimens of same date and from same locality as males and bred from isolated pupae corresponding in all details to the type. Not found biting.

Material in the British Museum.

Simulium palmeri, sp. nov.

♂. *Length*, 1.5 mm. *Antennae* black, covered with short grey pubescence. *Thorax*: prothorax velvet-black, covered with thick golden pubescence, increasing in area laterally and diminishing toward the median line; mesothorax velvet-black, covered with thick dark purple-brown iridescent pubescence; metathorax shiny slate-blue, dotted with a few sparse black hairs; scutellum fuscous, covered with dark hairs. *Pleurae* fuscous, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* velvet-black, covered with black hairs; an iridescent violet patch on the sides of the 2nd, 5th and 6th segments. *Legs*: front legs with coxae fuscous; femora fuscous, middle portion heavily covered with silvery pubescence, brassy in some lights; tibiae covered with silvery pubescence, dark brown at apex; tarsi almost black and very hairy; hind legs with coxae black; femora deep purple-brown; tibiae light golden-yellow at base, remainder deep purple-brown, with a

* Pomeroy, Ann. Mag. Nat. Hist. (9) vi, 1920, p. 79, pl. iii.

band of golden-yellow pubescence across basal third; tarsi almost black, second tarsal joint with excision near base, claws with distinct tooth at base. *Genitalia* very similar to those of *S. unicornutum*, Pomeroy; the general size appears to be smaller and the adminiculum not so long and the styli more prominent.

NIGERIA: Ubiaja, 15.i.1921.

Type in the British Museum.

Described from pupae found in swift hill-stream, alt. 900 ft. Bred from isolated pupae.

♀. *Length*, 1.5 mm. *Head*: antennae fuscous, covered with silver-grey pubescence, 1st, 2nd and part of 3rd segments honey-yellow; frons bare, slate-blue pollinose; face fuscous-blue pollinose in some lights, bare except for a few black bristles. *Thorax* dark brown, shining, covered with dark brown pubescence and with a few golden hairs, more numerous in front and laterally; scutellum fuscous, covered with long black bristles. *Pleurae* fuscous, lacking patch of soft hairs. *Wings* hyaline, radius unforked. *Abdomen* very dark brown, almost black, thickly covered with black hairs, last four segments shining dorsally. *Legs*: front legs with coxae fuscous, femora brown, with a pale yellow area at middle and along frontal margin, tibiae dirty yellow, banded dark brown just below base and at apex, tarsi dark brown; hind legs with coxae yellow, femora dark brown, paler at middle, tibiae dark brown, pale yellow at basal joint and with an oblique yellow band across middle; basal two-thirds of metatarsus yellow, remainder of tarsus brown, second tarsal joint with excision near base, claws with thick prominent tooth.

Described from specimens reared from isolated pupae taken on same date and from same locality as male type. Not found biting.

This species differs distinctly from *S. unicornutum*, Pomeroy, in the darker colouring of the legs, the colour and pubescence of the thorax, especially the scutellum, and also in the colour of the frons and face. There is no appreciable difference in the male genitalia, except in size and possibly in the adminiculum. The pupa, however, is very distinct and constant in the formation of the respiratory filaments, and on the several different characters of this and the adult stage the writer considers it to be a distinct species.

Pupa.—The respiratory filaments are somewhat similar to those of *S. unicornutum*, and consist of a single bent tube on either side (Pl. xiv, fig. 5). The angle at the base, however, is very distinct and more acute, and the tube is constricted into a series of globes. This globular appearance is very noticeable in the natural state, and in prepared mounts it may be seen that it is the result of the arrangement of the chitin forming the walls of the tube. The cocoon is of the wall-pocket type, very strong and without side openings. Described from many specimens similar to that from which male type emerged. Taken same locality and date. Material placed in the British Museum.
